ES78-MSFC-2241

Final Report

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STS PAYLOAD DATA COLLECTION AND ACCOMMODATIONS ANALYSIS STUDY

Volume I - Executive Summary

August 1978

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ES78-MSFC-2241

STS PAYLOAD DATA COLLECTION AND ACCOMMODATIONS ANALYSIS STUDY

VOLUME I

EXECUTIVE SUMMARY

AUGUST 1978

PREPARED FOR

INTEGRATED PAYLOAD AND MISSION PLANNING OFFICE
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GEORGE C. MARSHALL SPACE FLIGHT CENTER

CONTRACT NO. NAS8-32711

PREPARED BY

SPACE SYSTEMS DEPARTMENT
ENGINEERING SERVICES DIVISION
TELEDYNE BROWN ENGINEERING
HUNTSVILLE, ALABAMA

FOREWORD

This report summarizes the results of the Space Transportation System Payload Data Collection and Accommodations study (Contract NAS8-32711) performed by Teledyne Brown Engineering Company for the MSFC Integrated Payload and Mission Planning Office from August 24, 1977 to August 25, 1978. This study consisted of two basic tasks:

Task 1 - Payload Data Collection

Task 2 - Spacelab Payload Accommodations Analysis.

This report consists of the following:

Volume I - Executive Summary

Volume II - Payload Data Collection

Volume III - Accommodations Analysis.

The results of this study can be found in greater detail in various other reports published during the term of the study. These reports are:

Task 1 - ES78-MSFC-2251, OSTA Payload Planning Data, Volumes I and II, August 1978

Task 2 - ES77-NASA-02168, Accommodations Versus Space Payload Requirements, December 1977

ES77-NASA-2168, Assessment of Launch Site Accommodations Versus Spacelab Payload Requirements, December 1977

Launch Site Processing Requirements, April 1978

Presentation to NASA JURG Spacelab Payload Accommodations Assessment from User's Viewpoint, May 1978

ES78-MSFC-2213, Spacelab Payload Planners Handbook, May 1978

Spacelab Accommodations Assessment for Earth Observations, Combined Astronomy, and Dedicated Life Sciences, August 1978

ACKNOWLEDGEMENT

Teledyne Brown Engineering Company wishes to acknowledge the contributions, both management and technical, toward the goals of this study, of the following MSFC personnel:

R. E. Valentine
J. H. Sims
H. R. Gangl, Jr.
L. B. Allen
R. G. Beranek

In addition we wish to express our appreciation to the OSTA discipline offices at NASA Headquarters and the Field Center contacts for their cooperation and direct contribution to the data collection process. The technical assistance of MSFC Science and Engineering and Program Development personnel in both the data collection and accommodations analysis efforts is greatly appreciated.

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ABSTRACT

A brief summary of the objectives, activities, and results of the STS Payload Data Collection and Accommodations Analysis Study is presented in this volume. The study consisted of two basic tasks. Task 1 involved the development of a data base for investigations/instruments considered in mission planning activities for OSTA missions. Task 2 involved the definition and tracking of requirements/accommodations for integrated STS missions.

APPROVAL:

C. E. Kaylor
Project Manager

1. INTRODUCTION

The Space Transportation System Payload Data Collection and Accommodations Analysis study was initiated on August 24, 1977. This study was undertaken under a 1-year contract (Contract NAS8-32711) between Teledyne Brown Engineering Company and the Integrated Payload and Mission Planning Office of Marshall Space Flight Center.

The primary objectives of the study, as shown in Figure 1, were: (1) definition of the requirements of investigations/instruments and integrated missions which will be flown on the Space Transportation System (STS) in the foreseeable future, (2) definition of the accommodations/resources of the STS actually available for use by these investigations and missions, and (3) analysis of requirements versus accommodations to identify deficiencies, areas of concern, and needed improvements in the STS.

The study consisted to two distinct separate, although related, tasks. The project organization for the accomplishment of the objectives of these tasks is shown in Figure 2.

The objectives of Task 1 were to develop and maintain a data base for investigations/instruments which are germane to OSTA mission planning activities. These data were collected through communications with principal contacts for each investigation as designated by the NASA Headquarters OSTA discipline offices. Recent efforts have expanded also into the OAST disciplines for investigations/instruments which are included in OSTA mission planning activities. Principal data outputs of this study include:

- Summary volumes useful to top level management
- Detailed data for use in technical mission planning activities
- Input data to NASA/MSFC's mission planning computer programs.

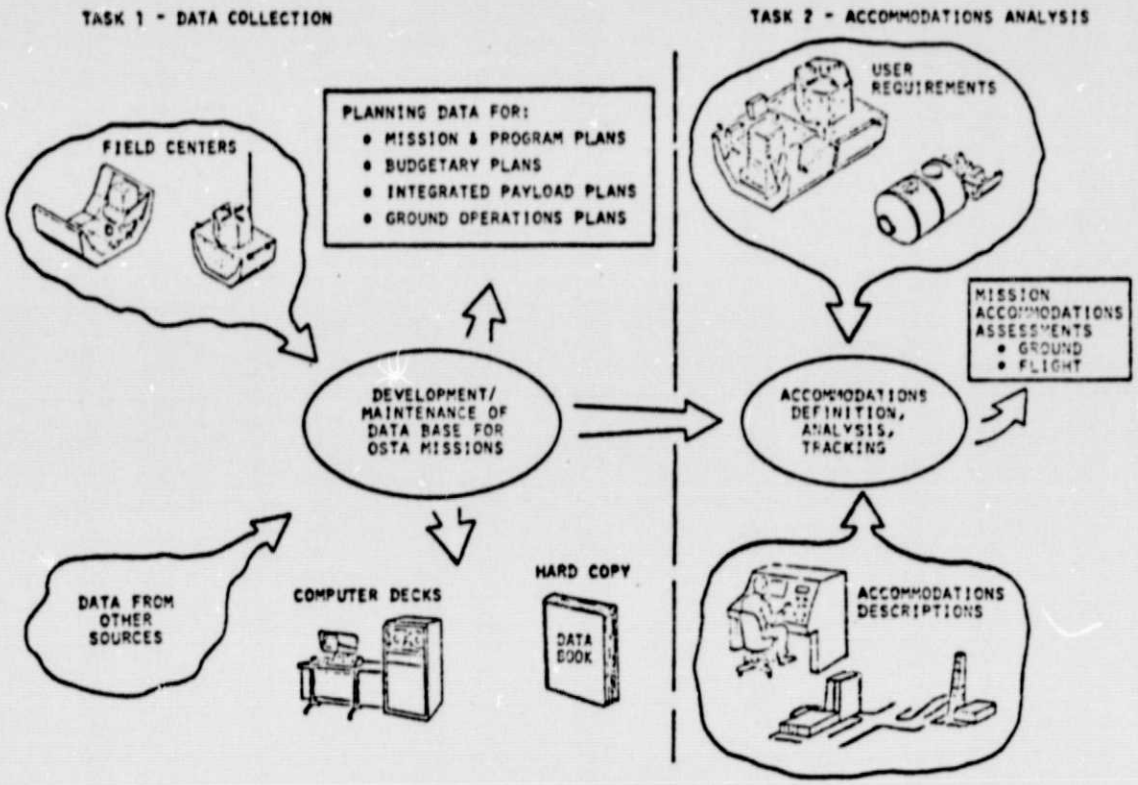

FIGURE 1. OBJECTIVES

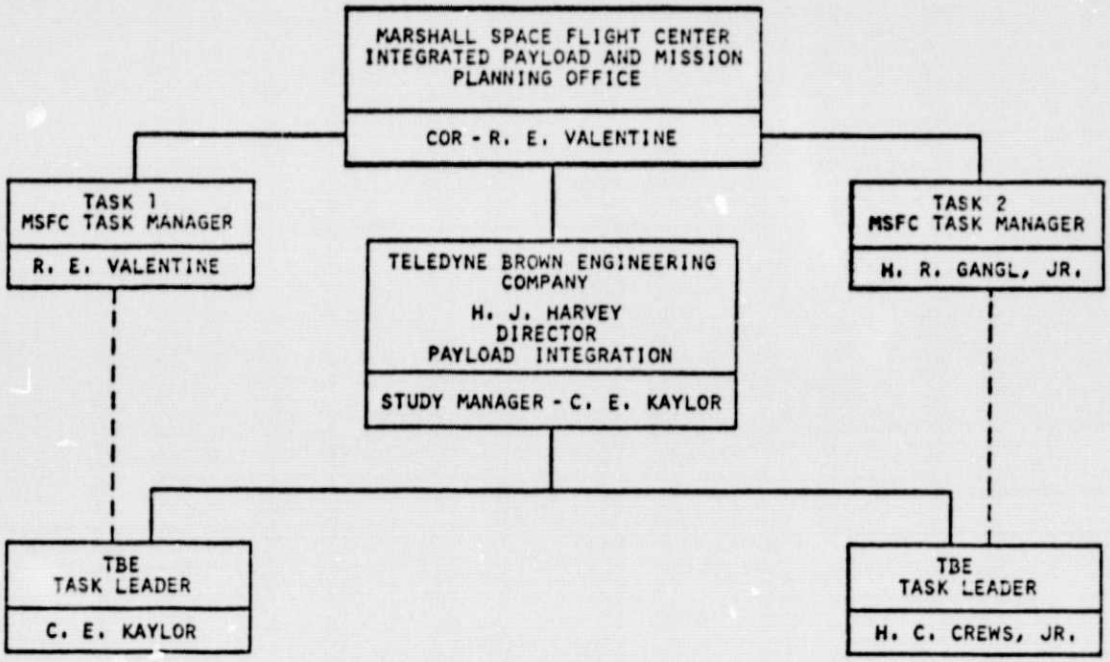

FIGURE 2. PROJECT ORGANIZATION

Task 2 objectives involve primarily the analysis of STS accommodations/descriptions against users' requirements. A major overall task is to track accommodations for and requirements of investigations/instruments/facilities and integrated missions as they evolve with the development of the Space Transportation System. Both ground and flight operations analyses are required, and outputs are a series of formal reports.

2. STS PAYLOAD DATA COLLECTION

The objective of the Payload Data Collection study was to develop and maintain a data base, in suitable format, for use in OSTA mission and program planning activities. As shown in Figure 1, data are gathered from existing documentation and through the principal contacts at the various NASA Field Centers, compiled into volumes, and keypunched into computer input format.

The primary thrust of the data collection activities was aimed at the development of a data base for use in future OSTA mission and program planning. The process for accomplishing this task involved efforts on the part of personnel in NASA Headquarters, Marshall Space Flight Center's Payload Office, and Field Center Principal Investigators/contacts as well as Teledyne Brown Engineering Company discipline specialists.

The involvement of high levels of NASA management personnel early in the program was highly contributive to the success of this project.

Discipline inventories of investigations/instruments have been fluid, and additions/deletions have changed requirements somewhat during the study. This, coupled with the fact that several investigations are in their infancy of development, has made it impossible to complete the data base on some of these investigations to the depth desired. However, a broad data base has been developed and delivered which will greatly enhance future mission planning activities.

The numbers of investigations/instruments/facilities included in each discipline area are shown in Table I. The numbers shown reflect the inventory as of the date of this report. All OAST items were added to the requirements list in April 1978.

The activities between TBE discipline experts and the principal contacts in developing the data sheets for use in the data bank are summarized in Table II. Although official submissions by principal

TABLE I. INVENTORY SUMMARY

OSTA DISCIPLINE	NUMBER OF PAYLOADS: INVESTIGATIONS/INSTRUMENTS/FACILITIES	FREE FLYING
RESOURCES OBSERVATIONS		
EARTH RESOURCES	11	4
EARTH DYNAMICS	4	3
ENVIRONMENTAL OBSERVATIONS		
WEATHER AND CLIMATE	12	5
ENVIRONMENTAL QUALITY	15	1
OCEAN CONDITION	2	2
MATERIALS PROCESSING	18	-
SPACE COMMUNICATIONS	5	3
OSTA TOTALS	67	18
OAST PAYLOADS	24	2
TOTALS	91	20

TABLE II. STATUS SUMMARY

OSTA SHUTTLE PAYLOADS / ACTION		DATA FORMS SENT TO PRINCIPAL CONTACT BY MSFC	INITIAL TBE PHONE CONTACT	TBE PERSONAL CONTACT WITH PRINCIPAL CONTACTS	RECEIPT BY TBE OF FILLED IN FORMATS	DATA SENT TO PRINCIPAL CONTACT FOR REVIEW AND SUBMITTAL	DATA SUBMITTED BY PRINCIPAL CONTACT	INCLUSION OF FORMAT IN DATA PACKAGE
RESOURCES OBSERVATIONS								
EARTH RESOURCES	(15)	15	15	15	15	15	9	15
EARTH DYNAMICS	(7)	7	7	4	5	6	6	6
ENVIRONMENTAL OBSERVATIONS								
WEATHER AND CLIMATE	(17)	17	17	13	10	15	10	15
ENVIRONMENTAL QUALITY	(16)	16	16	16	16	16	12	16
OCEAN CONDITION	(4)	4	4	4	2	2	2	2
MATERIALS PROCESSING	(18)	18	18	17	1	10	3	10
SPACE COMMUNICATIONS	(8)	8	8	8	1	8	5	8
OSTA PAYLOADS	(85)	85	85	77	50	72	47	72
OAST PAYLOADS	(26)	0	26	5	0	23	0	26
TOTAL	(111)	85	111	82	50	95	47	98

contacts are behind anticipated schedule, the data bank is complete insofar as data are presently available. A complete compilation of data has been published on the current active inventory. Data for each entry were collected with the cooperation and full cognizance of the appropriate principal contact.

2.1 FORMAT REFINEMENT

The initial task under the contract involved developing a suitable data format for multiple uses. Since previous formats had been burdensome both to the instrument developer and the user of the data, the primary objective was to simplify the format to include only the data necessary for detailed mission planning with minimum impact on the responsible payload contact.

The format was developed concurrently with the initial mission planning data exercise. The two efforts were mutually supportive of each other. Evaluation of needs of the mission plan contributed to the development of a format to meet those needs.

The criteria used for the format development include:

- Compatibility with Engineering Requirements Document format
- Modular construction for multiple uses
- Ease of completion and use.

The format was organized into four major sections - general information, experiment equipment description, physical characteristics of the equipment/facility, and operational requirements. The experiment equipment description section is deleted from the free-flying payload format because mission planning does not require this information. Moreover, science information on shuttle experiments, which will be carried on free-flyers for long-term use, can be obtained from shuttle payload data sheets.

2.2 MISSION PLANNING ACTIVITIES

During the course of the data collection study TBE participated in mission planning activities. The first exercise was accomplished during the early months of the contract while the data format was under development. Summary level data were compiled on 28 investigations/instruments in the OA Flight Requirements at that time. A book of data was published in November 1977 covering these investigations.

The mission model planning activities at MSFC for the 1980-85 Mission Plan required data on many investigations/instruments not found in the payload planning data books. In order that effective planning could be accomplished TBE was tasked as indicated in Figure 3 to acquire data on 16 additional OSTA and 26 OAST investigations/instruments which were included to the OSTA model. The results were that on a quick turn-around basis sufficient data were delivered for this mission planning activity. In addition TBE's discipline specialists were available for consultation with MSFC PD personnel involved in this mission planning activity.

The results of this study including detail and summary data were submitted by technical letter. In addition a summary matrix of parameters on each investigation/instrument in the payload model was compiled to facilitate "quick-look."

2.3 DATA COLLECTION PROCESS/RESULTS

The data collection process which is depicted in Figure 4, includes the following basic steps:

- Inventory development by NASA Headquarters (OSTA)
- Data requirements definition by MSFC Payload Office
- Appointment of principal contacts/notification of principal contacts activity by OSTA
- Introduction of format/TBE personnel to principal contacts by MSFC
- Data acquisition by TBE in concert with Field Centers personnel

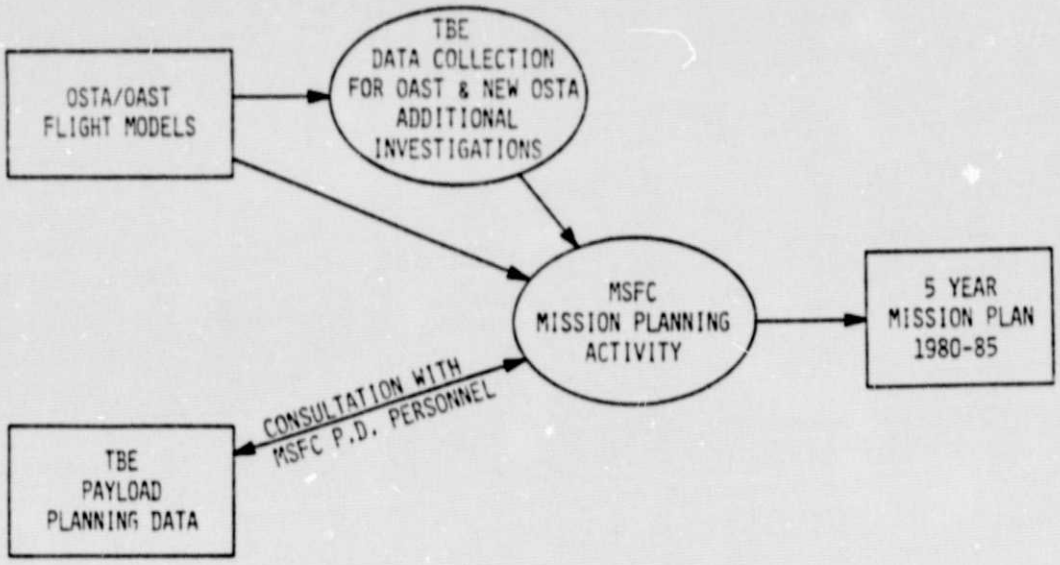

FIGURE 3. MISSION MODEL PLANNING DATA

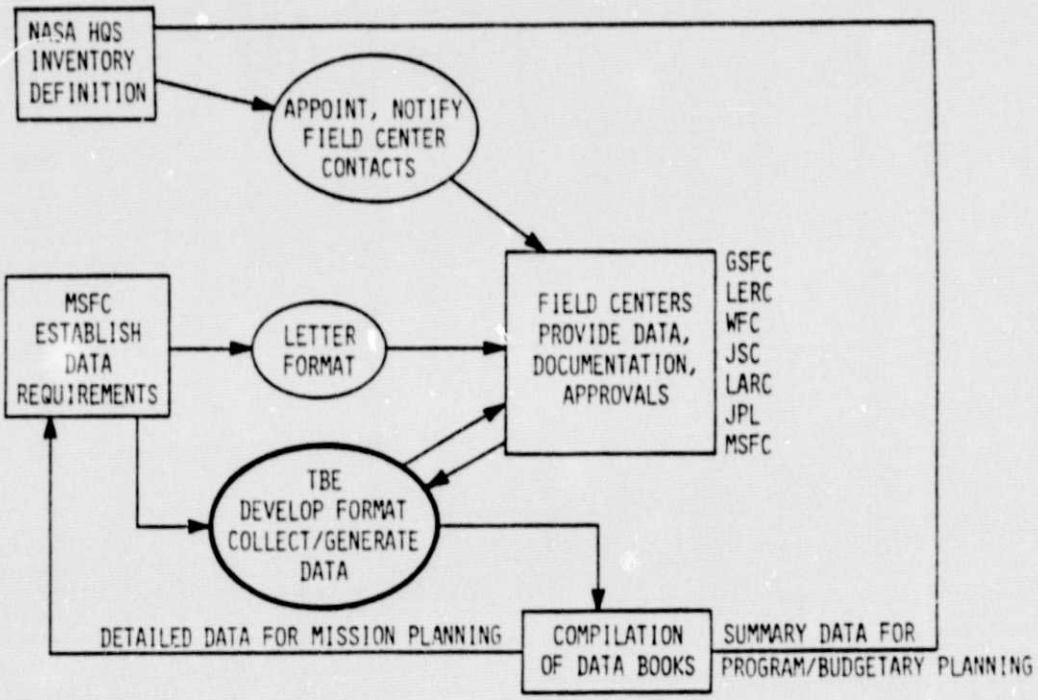

FIGURE 4. DATA COLLECTION PROCESS/RESULTS

- Completion of data sheets by TBE or Field Centers
- Approval of data by principal contacts
- Compilation/publication of data by TBE.

The outputs of the activity include published volumes of detailed and summary level data for use in mission planning and management functions, respectively. Publication of data on the active OSTA inventory of investigations has been accomplished. A sample detailed data format for reference is shown in Figure 5. Data on 42 additional investigations/instruments have been collected for use in mission planning work. Twenty-six of these additional investigations are in the OAST inventory. A preliminary copy of the Summary Data Book has been delivered on these. All of these 42 additional investigations have been included in a summary matrix for use in mission model planning activities.

Data for all investigations/instruments involved in the collection process have been entered into a computer data bank. A deck of data cards was delivered in format compatible with input requirements of the Marshall Interactive Planning System (MIPS) computer program. An IBM 1130 disc was also loaded with these data for easy access and search routines. Both the computer data inputs and the data books are designed for easy up-date of data items and for inclusion of additional investigations/instruments as the STS program evolves.

2.4 MANAGEMENT REVIEW

A summary of data was compiled on all investigations/instruments in the OSTA inventory. These data, subdivided by discipline, provide a top level overview of descriptions, objectives and requirements of each investigation/instrument being considered for near-term OSTA missions. Bar charts point out the tall-poles in requirements of Spacelab resources. These data are useful for pointing out major drivers and for compatibility analysis of investigations/instruments for top level mission planning studies. Special requirements, which may not be obvious from data observation, for investigations/instruments are also pointed out in this summary in order to facilitate mission plans.

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OFFICE OF SPACE AND TERRESTRIAL APPLICATIONS
INVESTIGATION/INSTRUMENT/FACILITY PLANNING DATA

1-GENERAL INFORMATION

Name/Acronym Large Format Camera (LFC) Code No. [illegible]
Orig. Date [illegible]
Discipline Earth Resources Rev. Date
Submitted by [illegible] NASA HQ Approval
Contact [illegible] Center JSC Phone [illegible]
Contact Center Phone

Objective At the present time, the Orbiter Camera Payload System (OCPS) is configured with a single Large Format Camera (LFC) but future applications may contain one or more additional camera configurations. The major objective of the earth's land and ocean surfaces (and meteorological phenomena) for geological exploration, cartography, and renewable resources analysis.

Description (Physical Package, Experiment Activities, On Orbit Operations, Control, Use of Payload Specialist, etc.) The OCPS will be carried in the STS cargo bay and will require a hybrid pallet or Standard Test Rack (STR) for mounting. The OCPS will require STS power, command and telemetry services as well as time from one of the STS crew members for operation. The OCPS uses active heating and passive cooling and is comprised of the LFC, mount structure, environmental enclosure, pneumatic supply and electronics assembly. The LFC has a maximum frame capacity of 1,400 frames or ground track coverage of [illegible] km (at [illegible] km altitude).

Data Sources

Project Plan for the Orbiter Camera Payload System, JSC-13839, 1 Feb. 1978.

Technical Specification Orbiter Camera Payload System, JSC- (TBD)

OCPS Users Handbook, JSC-(TBD)

Development Status

			Time (mos.)
Planning	☐	New Development	
Definition Studies	☐	Modify/Upgrade Existing Hardware	
AAFE	☐		
Development	☒	Prepare/Refurbish Existing Hardware for Flight	
Existing Hardware	☐		

Flight Schedule (Circle No. If Approved for Flight)

CY	79	80	81	82	83	84	85	86	87	88	89	90	91
No. of Flights		1	[illegible]	[illegible]	[illegible]	2	[illegible]						

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Code No. [illegible]

2-EXPERIMENT EQUIPMENT DESCRIPTION

Optical: Yes ☒ No ☐ Spectral Range [illegible] nm
Detector Type Film Detector Operating Temp. TBD
Telescope Type N/A

Camera:	Visible ☒		Infrared ☐	
Radiometer:	Extinction ☐		Cavity ☐	
	Correlation ☐		Other	
Photometer:	Extinction ☐		Other	
Interferometer:	Michelson ☐			
	Fabry-Perot ☐			
	Grating ☐			
Spectrometer:	Filter ☐		Other	
	Grating ☐			
Lidar:	☐		Type	

Microwave: Yes ☐ No ☒ Frequency Band ______ Antenna Type ______
Radar ☐
Radiometer ☐
Imaging ☐ Type ______

Processing/Manufacturing: Yes ☐ No ☒

Material: Furnace Type ______ Temp. Range ______
Zone Refining ______
Crystal Growing: Melt ☐ Solution ☐ Vapor ☐
Alloying ☐
Purification ☐

Biological: Electrophoresis ☐
Other Type Separation ☐
Others ______

Fluid Phenomena: Flocculation ☐
Convection ☐
Migration ☐
Multiphase ☐

Additional Descriptions (Specific Instrument Characteristics): Lens focal length is 30.5 cm and the image format is 22.9 cm (Y direction) and 45.7 cm (X direction).

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Code No. [illegible]

3-PHYSICAL CHARACTERISTICS

Mass and Geometry

Total Launch Weight	kg [illegible]	Payload Volume	cu m [illegible]
Landed Weight	kg [illegible]	Pressurized Equipment	cu m [illegible]
Pressurized Equipment	kg [illegible]	Unpressurized Equipment	cu m [illegible]
Unpressurized Equipment	kg [illegible]	Control & Display Area	sq m N/A

Major Mission Equipment

Identification/Function	Qty	Wt (kg)	Dimension (m)			Location in Orbiter
			[illegible]	[illegible]	[illegible]	
LFC lens cone assy	1	150	.64 Dia		.74	Cargo bay
LFC film magazine assy	1	107	.91	.51	.61	"
LFC electronics assy	1	46	.61	.61	[illegible]	"
Environmental control assy	1	22	.8	.8	.7	"
Mount structure	1	20*	1.07	1.22	1.7	"
Pneumatic supply	1	60*	.63	.4	.25	"
Cabling	5	34	5 (total)			"

Support/Integration Equipment Required in the Orbiter (If Known)

	Qty	Description/Location	Provided by Exp	[illegible]	[illegible]
Keyboard/Data Display Unit	1	Orbiter keyboard and CRT	[illegible]		
Computer for Data and/or Exp.	1	Orbiter [illegible]		[illegible]	
Remote Acquisition Unit					
High Rate Digital Recorder					
Closed Circuit TV					
Cold Plates					
Thermal Blankets			[illegible]		
Exp. Heat Exchanger					
Single Racks					
Double Racks					
Airlock					
Pointing Subsystem					
Camera					
Remote Manipulator Arm					
Optical Window					
Multiplexer-Demultiplexer (MDM)	1	Orbiter MDM			[illegible]

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Code No. [illegible]

Power (28 ± 4 Vdc)

		Pallet		Module
Standby Power	W	[illegible]	W	
Operating Power	W	[illegible]	W	
Operating Power Duration	W	[illegible]	W	
Peak Power	W	[illegible]	W	
Peak Power Duration	W	[illegible]	W	
Heater Pwr (mode)	W	45		

Environment

Temp., Min/Max (K)	TBD	Tolerable EMI Level (dBW/m²)	(*)
Humidity, Min/Max (%)	N/A	Tolerable Rad. Rate (J/kg-sec)	(*)
Inst. Outgas Rate (g/hr)	[illegible]	Tolerable Acoustics Level (dBA)	(*)
Inst. Rad. EMI Level (dBW/m²)	TBD	Tolerable Contamination Level (particles/m²)	TBD

(*) as specified in JSC [illegible], 11/16/77

Potential Hazards

High Pressure ☒ Cryogenics ☐
Pyrotechnics ☐ Propellants ☐
Radiation ☐ Corrosives ☐

Other ______

Special Requirements (Integration Handling Equipment, Mounting Requirements, Specific Component Cooling, Power/Data Connector Locations)

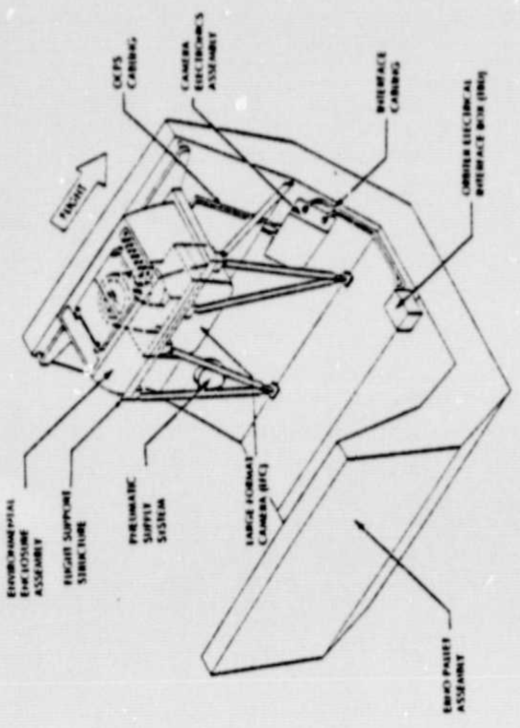
Integration handling equipment is TBD.
Mounting requirements is TBD.
Specific component cooling is passive cooling and active heating.
Power/data locations are TBD.

Installation Constraints (Scan/Deployment Clearances, Orientation, etc.)

1. LFC optical axis must be parallel to the Z axis.
2. LFC must be pointed in the +Z direction.
3. LFC format long axis (18") must be parallel to the velocity vector.
4. LFC +X axis must be into the forward velocity vector.

FIGURE 5. DATA FORMAT

Code No. [illegible]



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4-OPERATIONAL REQUIREMENTS

Orbit Characteristics

	Desired	Minimum	Maximum
Altitude, km	[illegible]	[illegible]	[illegible]
Inclination, deg	[illegible]	[illegible]	[illegible]

Effect of Deviations in Orbit Characteristics on Objectives The system requires a circular orbit for maximum data utilization. However, corrections can be made real time to compensate for an elliptical trajectory. Would like two different altitudes (200 and 250 km) on first flight.

Launch Window (Time of Day and/or Season) (TBD) Early CONUS coverage is high priority, world-wide is highly desirable.

Target Viewing Requirements

Orientation Requirements Earth [X] Solar [ ] None (Low "g") [ ]
Limb [ ] Nadir [X] Solar Occultation through Limb [ ]
Other

Targets CONUS [X] All Land Masses [X]
Specific Targets TBD

Constraints Look Angle from Nadir (deg) 0
Sun Elevation Angle (deg) 10 to 90

Shadow/Sunlit Portion of Orbit Shadow Requirements [ ]
Sunlit Requirements [X]
Not Sensitive [ ]

Other Viewing Requirements Stellar - inflight calibration, therefore, a stellar inertial attitude must be maintained one or two times during a mission for the required 3 to 10 minute film exposure.

Number of Observations: Minimum 20 Desired [illegible]
Observation Duration Hr/Obs 0.15 Mission Duration Hr [illegible]

Pointing, Stability, and Control

Pointing Accuracy, arcsec ±1200 Stability Rate arcsec/sec 100
Total Pointing Time, hr/msn [illegible] Field of View (Half Angle) ____ deg Note
Stability, arcsec 360 Scan Angle: x N/A deg, y N/A deg

Primary Control of the Instrument During Orbital Operations:

Aft Flight Deck [X] Module [ ] Real Time from POCC [ ] Other [ ]

Description The STS MDM driven by the Orbiter CPC and keyboard system appears to be adequate.

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Code No. [illegible]

Payload Personnel

Estimated No. of P/L Personnel 1 (part time)
Total P/L Personnel Time, Man hr/msn [illegible] hr min. (16.3 hr max.)
Describe How Personnel Used Prepass prep and pass execution.

Note: Maximum LFC operate time is dependent on: (1) mission duration; (2) orbit altitudes, and (3) overlap setting.

Time per Experiment Cycle/Observation

	Avg Time (hr)	Crew Time (hr)
Setup	[illegible]	[illegible]
Operating/Monitoring	[illegible]	[illegible]
Shutdown	[illegible]	[illegible]
Other	[illegible]	[illegible]
Total	[illegible]	[illegible]

Specific Background Required of Instrument Operator: None

If the Operator of your Instrument has a General Discipline Competence, How Much Training Time would you Anticipate to Familiarize the Operator with your Instrument and Research? 15 hr

EVA

No. of Planned EVA per Msn None EVA Duration ____
Purpose of EVA ____

Data/Communications Support

Direct P/L-to-Gnd RF Comm Req'd? [ ] Real Time ____ kbps
Voice [X] Near Real Time ____ kb/orbit (within one orbit)
TV B&W [ ] Color [ ] Other (Describe) ____

Data Acquisition

Digital Rate, (max), kbps .05
Digital Qty, Total, kb/msn [illegible]
Analog Bandwidth, (max), Hz [illegible] (temp sensors)
Analog Duration, Total, hr/msn [illegible] hrs ots. TM sample 3 hrs only
TV Bandwidth, (max), Hz N/A
TV Duration, hr/msn N/A

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Code No. [illegible]

Other STS Accommodations

Multiplexer - demultiplexer (MDM) driven by the Orbiter CPC and keyboard system and the CRT display. Additionally, need real time true ground velocity and altitude. During data pass, the LFC needs access to spacecraft timer to sample data at the instant of exposure midpoint.

(Additional requirements are TBD).

Payload Operations Control Center (POCC)

Desired Output Form:
Tape [ ] Strip Chart [X]
Tabular Report [X]
Digital TV [ ]
Required Natural Environment Data: (Meteorological?)
World Wide Metrological [X]
Space Environment [ ]
Ground Monitoring Requirements:
Continuous? [ ] Periodic? [X]
Real-Time? [X]

Remote Site Support [ ]
Real-Time Data Processing & Display [ ]
Internal & External Voice Comm [ ]
Crew Conversation Tape [X]
Initiation of Command [X]
Command: Display [ ] Printout [X]
Trajectory History [X]
Experimenter provided GSE ____
(None anticipated)

Ground Operations, Environment, and Constraints (Describe Function and/or Time when Needed)

Clean Room Environment Required? Class 100,000
Temperature Control Required? °K [illegible]
Power Required? 28 Vdc
[illegible] Vac (Integration area only
Humidity Control Required? % N/A
Tolerable Level [illegible] max. % R.H.
Experiment Access Film loading at T-(TBD hrs.)
Fluids Servicing [illegible]
Cryogenics Servicing N/A

Launch/Landing Ground Support & Equipment

TBD

NOTES (IDENTIFY BY SECTION NO.)

4. pg. 6 Field of view, camera frame X = [illegible], Y = [illegible], diagonal = [illegible]
4. pg. 7 Operator training, only 12 hr of training is mission unique
4. pg. 7 Data acquisition - onboard recorders will record all output. Real time telemetry will be periodic and not exceed 3 hours.

*Estimate by TBE

FIGURE 5 - Continued

3. STS PAYLOAD ACCOMMODATIONS ANALYSIS

The purpose of this task, Payload Accommodations Analysis, has been to determine the ground and flight accommodations requirements for STS/Spacelab payloads and missions, define flight and ground accommodations from available facility descriptions, and to assess the adequacy of accommodations against payload requirements. Figure 6 illustrates the operation of the accommodations analysis effort using documented user requirements and facility descriptions to develop integrated payload requirements and accommodations descriptions which are used in the performance of accommodations assessments. Note that material from the user requirements facility description, payload requirements, and accommodations definitions were used in the generation and maintenance of the payload accommodations reference file.

3.1 ASSESSMENT OF LAUNCH SITE ACCOMMODATIONS

A study of the "KSC Launch Site Accommodations Handbook for STS Payloads" was conducted to assess its description of accommodations against users' requirements. Criteria were developed for review of the document. As indicated in Figure 7 four missions' requirements were then determined and evaluated against the handbook description. As a result of this study recommendations for changes in the handbook descriptions were made. The handbook was subsequently revised to incorporate these changes. A document, "Assessment of Launch Site Accommodations Versus Spacelab Payload Requirements" was generated as a result of this study. A lack of test and checkout requirements in the time frame of this study led to a further study of this facet of Launch Site Accommodations.

3.2 LAUNCH SITE PROCESSING REQUIREMENTS STUDY

In this study the processing requirements were determined for payloads in the minimum risk category (payloads with a high degree of importance on success). In addition the conditions for deviation from these requirements for payloads of assigned levels of risk were recommended. Particular attention was given to test and checkout

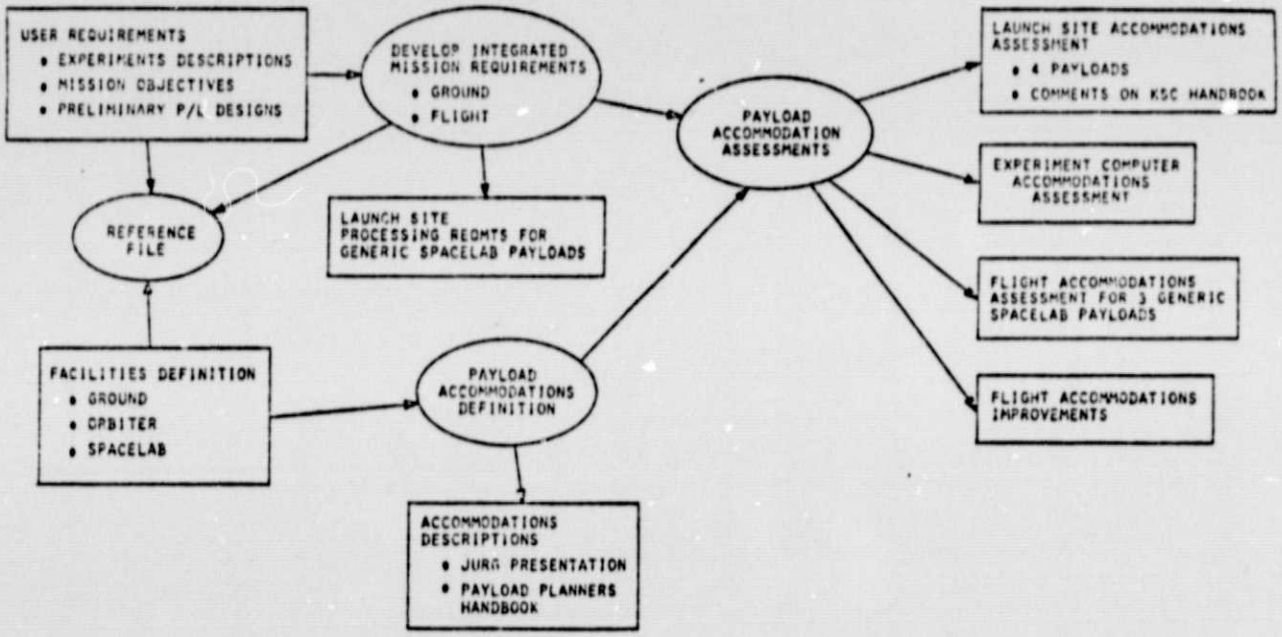

FIGURE 6. PAYLOAD ACCOMMODATIONS ANALYSIS

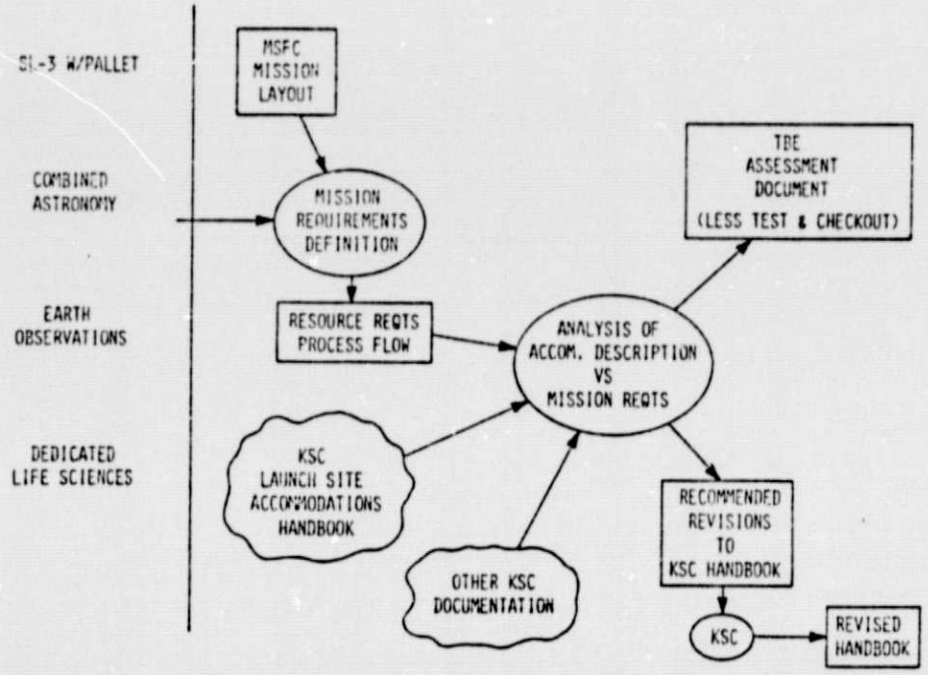

FIGURE 7. ASSESSMENT OF LAUNCH SITE ACCOMMODATIONS

requirements at Levels III, II and I integration. Definition of test and checkout accomplished at Level IV was included. Special support requirements for Data Processing, Display, Facilities, and Ground Support Equipment were defined. Processing functions were defined as explicitly as possible without specific payload reference.

3.3 ECOS REQUIREMENTS REVIEW

TBE was requested to participate in a Team 1 review of the September 1977 ECOS Requirements Document. After review of the document 19 Review Item Discrepancies (RID's) were submitted for consideration of the Review Team. After these and other RID's from the review were considered, TBE participated in the follow-up action on four RID's. The recommendations were:

- To use the proposed ECOS keyboard language instead of alternate languages.
- To have an experiment-provided counter operating with the Usertime Clock to obtain ±10 ms accuracy and 10 μs resolution when required.

3.4 REFERENCE FILE

A file of STS accommodations was generated and delivered for customer reference and use. The file consists of notebooks of 8 x 10 inch photographs and drawings, supporting text, viewgraphs, and negatives of the figures. The following subjects are treated in the file:

- Space Shuttle
  - Missions
  - Costs
  - Mission sequences
  - Orbiter and its accommodations
  - Solid rocket booster
  - External tank

- Spacelab
  - Accommodations
  - Typical applications
  - Mission 1
  - Mission 2
  - Mission 3
  - Upper stages.

3.5 OSTA PAYLOAD INTEGRATION COST STUDY DATA

A study was conducted to generate experiment data necessary for input to a Level IV Integration Cost Study by the contractor to MSFC. The results of this study provided the following:

- Definition of experiment data pertinent to Level IV integration cost study
- Definition of special Level IV test and verification requirements
- Definition of Level IV interfaces
  - Branching unit essential power
  - EPDB
  - Battery requirements
  - Cables through disconnect panel
  - Experiment switching panel power
  - Number of software modules.

3.6 FLIGHT ACCOMMODATIONS STUDY

The purpose of this study was to summarize the Spacelab accommodations as defined in the June 30, 1977 Spacelab Accommodations Handbook (SPAH) and compare them with the requirements of payloads as defined in the Spacelab System Requirements Document (SRD), revision 1, dated May 1975. Discrepancies between these two documents were noted. Also

the Spacelab CDR and design expectations were compared to the SPAH. The results of this effort were reported in presentation format for presentation to NASA JURG. The presentation included recommendations for improvements.

Based on the assessment described above a TBE document, "Spacelab Payload Planners Handbook," was formulated and published. Backup data were incorporated as well as definition of essential MDE for each Spacelab configuration. Accommodations available to payloads and accommodations constraints were defined.

The Flight Accommodations Study was extended to define Spacelab improvements supported by the requirements of three generic missions. The study defined mission requirements for the three missions, analyzed the accommodations versus requirements, identified problem areas, and assessed improvements which are supported by the mission requirements. This study was integrated with other material from NASA/MSFC inhouse studies into a presentation to ESA/NASA JURG.